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September 2001

Department of Energy
Office of Science
Laboratory Technology Research Program

Proposals Chosen for FY 2001 Rapid Access Projects

Advanced Materials Research

Title:	Nano-Phase Support Materials as Catalysts for Ultra-Deep Sulfur Removal from Crude Oil and Transportation Fuels
Laboratory:	Argonne National Laboratory
Principal Investigator:	Christopher Marshall
Industry Partner:	Texaco Houston, TX
Amount of Award:	$60,000
Brief Summary:	The objective of this project is to increase the activity and selectivity of molybdenum disulfide (MoS_2), to achieve economical ultra-deep removal of sulfur from samples of gasoline, diesel, and heavy crude by nano-sizing MoS_2 catalyst particles. The project will use a newly emerging sonochemical synthesis - synthesis of materials in the presence of ultrasonic waves. The drop-in replacement economics will be evaluated for potential use in oil refineries.

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Title:	High-Density Chromium Nitride as an Undercoat for Near-Frictionless Carbon
Laboratory:	Argonne National Laboratory
Principal Investigator:	John Woodford
Industry Partner:	Phygen Minneapolis, MN
Amount of Award:	$50,000

Brief Summary:	The objective of this project is to develop a duplex chromium nitride near-frictionless carbon film capable of providing extreme wear resistance and reduced friction to sliding engine and drivetrain components in advanced diesel engines. The key advantages expected from this film are extended wear life, reduced maintenance costs, improved reliability, and increased energy efficiency resulting from decreased parasitic frictional losses in sliding engine and drivetrain components.

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Title:	The Search for Co-Existing Oxide Liquid Phases with Anomalous X-Ray Scattering
Laboratory:	Argonne National Laboratory
Principal Investigator:	David Price
Industry Partner:	Containerless Research Evanston, IL
Amount of Award:	$60,000
Brief Summary:	The objective of this project is to apply Argonne's conical levitation techniques, used previously with total x-ray scattering, to anomalous x-ray scattering measurements at the Advanced Photon Source. This should lead to a new avenue for processing advanced materials from the molten state.

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Title:	Improving the Fabrication of High-Current Superconducting YBaCu0 Tapes
Laboratory:	Brookhaven National Laboratory
Principal Investigator:	Mas Suenaga
Industry Partner:	Oxford Superconducting Technology Carteret, NJ
Amount of Award:	$60,000
Brief Summary:	The objective of this project is to gain a detailed understanding of the factors controlling the nucleation mechanism in the formation of expitaxial thick films of YBCO on practical

substrates. The goal is to develop a commercially viable process for the production of YBCO conductors.

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Title:	A Control System Upgrade for Soft X-Ray Magnetic Nanostructure Studies at the Advanced Light Source
Laboratory:	Lawrence Berkeley National Laboratory
Principal Investigator:	Jeffrey Kortright
Industry Partner:	IBM San Jose, CA
Amount of Award:	$50,000
Brief Summary:	The objective of this project is to develop a fully-integrated, PC-based control system for soft x-ray magnetic nanostructure studies. This system will enable an increasing range of soft x-ray magneto-optical measurements into the soft x-ray region to study the nanoscale magnetic and chemical structure of materials.

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Title:	Development of Carbon and Activated Carbon Nanofiber Webs
Laboratory:	Oak Ridge National Laboratory
Principal Investigator:	Tim Burchell
Industry Partner:	ESpin Technologies Chattanooga, TN
Amount of Award:	$54,000
Brief Summary:	The objective of this project is to prepare and characterize carbon nanofiber webs. Organic polymeric nanofiber webs will be the starting material. The project will identify preferred methods of stabilizing, carbonizing, and activating the webs, and characterize the carbonized and activated webs. Activated carbon fibers offer inherent advantages over granular activated carbon materials for gas separation, gas storage, and other energy storage device applications, such as batteries and ultra capacitors.

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Title:	Properties of Vacuum-Deposited Thin Films of Lithium Phosphorous Oxynitride with an Expanded Composition Range
Laboratory:	Oak Ridge National Laboratory
Principal Investigator:	Nancy Dudney
Industry Partner:	Integrated Power Solutions Princeton, MN
Amount of Award:	$60,000
Brief Summary:	The objective of this project is to synthesize and characterize lithium phosphorous oxynitride (lipon) thin films with nitrogen and lithium concentrations in excess of typical compositions. The project will investigate the oxygen-nitrogen equilibrium for the lipon films during film deposition and explore several means to improve the control of the oxygen partial pressure in the reactive plasmas. This improvement should be useful in a large range of film deposition processes.

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Title:	High Thermal Conductivity Lossy Dielectrics
Laboratory:	Oak Ridge National Laboratory
Principal Investigator:	Terry Tiegs
Industry Partner:	Ceradyne Costa Mesa, CA
Amount of Award:	$47,000
Brief Summary:	The objective of this project is to use a multilayer composite approach to fabricate alternating layers of high thermal conductivity materials (such as aluminum nitride) and layers of high dielectric loss. The project will determine how the layer thickness and arrangement affect the thermal conductivity and loss in the material. Applications of the lossy dielectrics include commercial radar, microwave communications, satellite uplinks, and medical and scientific accelerators.

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Intelligent Processing and Manufacturing Research

Title:	Development of Low Temperature Copper Brazing Technology for Manufacture of Advanced Cooling Devices
Laboratory:	Ames Laboratory
Principal Investigator:	James Foley
Industry Partner:	Josephson Manufacturing Fort Dodge, IA
Amount of Award:	$47,000
Brief Summary:	The objective of this project is to develop a low temperature copper brazing material and processing technology that will enable manufacture of an efficient and easily-recycled copper-based cooling device. Advantages of such devices include lower scrap rates, more robust processing, environmentally-friendly manufacture, and much greater throughput rates.

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Title:	Development of a Two-Dimensional Laser Doppler Linear Actuator System
Laboratory:	Argonne National Laboratory
Principal Investigator:	Deming Shu
Industry Partner:	Optodyne Compton, CA
Amount of Award:	$60,000
Brief Summary:	The objective of this project is to develop a prototype of a two-dimensional laser Doppler linear actuator system with subnanometer positioning resolution over a 50mm x 50 mm travel range. This system is expected to have about one order-of-magnitude better resolution and three orders-of-magnitude greater dynamic range than the best actuators that are commercially available.

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Title:	Fundamentals of SF_6 Cover Gas Protection for Magnesium Melts
Laboratory:	Argonne National Laboratory
Principal Investigator:	John Hryn
Industry Partner:	Noranda Magnesium Franklin, TN
Amount of Award:	$60,000
Brief Summary:	The objective of this project is to understand and define the protective mechanisms occurring during coverage of molten magnesium by gases containing SF_6. This should lead to the development of an alternative cover gas system, which is expected to reduce global warming.

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Title:	Precision Pulse-Processing Circuits for Spectroscopic Imaging
Laboratory:	Brookhaven National Laboratory
Principal Investigator:	Paul O'Connor
Industry Partner:	eV Products Saxonburg, PA
Amount of Award:	$60,000
Brief Summary:	The objective of this project is to develop an Application Specific Integrated Circuit which will provide discrimination, arbitration, multiplexing, peak detection, and derandomization of the analog pulses generated by a multi-element pixel sensor. The most demanding imaging applications should benefit from the size, power, and cost improvements offered by this technology.

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Title:	Metrology Tools for Surface Profile Measurement
Laboratory:	Brookhaven National Laboratory
Principal Investigator:	Peter Takacs

Industry Partner:	Ocean Optics Dunedin, FL
Amount of Award:	$60,000
Brief Summary:	The objective of this project is to develop a next-generation Long Trace Profiler (LTP) which uses a super-stable LTP optical head. The project will redesign the support structure of the existing LTP (utilizing lightweight, stiff structures), and will redesign the control software for modularity and ease of expansion. These improvements will open up new areas of applicability of the LTP, such as in-situ measurements at individual beam lines and in-process metrology on the shop floor.

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Title:	Proof of Principle of a High-Event Rate, High-Spatial Resolution Detector for Powder Diffraction Studies
Laboratory:	Lawrence Berkeley National Laboratory
Principal Investigator:	Jacques Millaud
Industry Partner :	BRUKER-AXS Madison, WI
Amount of Award:	$60,000
Brief Summary:	The objective of this project is to develop an advanced detector for powder diffraction analysis which is capable of supporting event rates more than three orders-of-magnitude higher than existing systems. This detector should enable novel, high-resolution, time-resolved experiments, protein crystallography, and small angle scattering at synchrotron beam lines.

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Title:	Energetic Silver Deposition for Optical Applications
Laboratory:	Lawrence Berkeley National Laboratory
Principal Investigator:	Andre Anders
Industry Partner:	AFG Development Petaluma, CA

Amount of Award: $50,000

Brief Summary: The objective of this project is to explore energetic (self-ion-assisted) deposition as an alternative deposition process for the formation of visually transparent, infrared reflectors. The project will focus on the deposition process from a fundamental point of view by investigating the effect of greater energy of the depositing material on film properties of interest. The result of this research could provide the foundation for a potentially revolutionizing shift in deposition technology in the field of spectrally selective coatings.

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Title: Development of Negative Heavy Ions for Ion Implantation

Laboratory: Lawrence Berkeley National Laboratory

Principal Investigator: Ka-Ngo Leung

Industry Partner: AXCELIS
Beverly, MA

Amount of Award: $60,000

Brief Summary: The objective of this project is to demonstrate that negative heavy ions can be efficiently produced in quantities sufficient for industrial ion implantation applications. Key advantages of this approach include a lower impurity component in the accelerated beam and avoidance of the use of toxic gas.

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Title: Defect Engineering and In-Situ Internal Oxidation for Development of Thin SOI Substrates Using SIMOX

Laboratory: Oak Ridge National Laboratory

Principal Investigator: O. W. Holland

Industry Partner: Ibis Technology
Danvers, MA

Amount of Award: $58,500

Brief Summary: The objective of this project is to develop a viable and more cost-effective Separation by Implantation of Oxygen (SIMOX) wafer technology. This will be used to fabricate silicon-on-insulator (SOI) SIMOX wafers commensurate with the structural and electrical properties required by advanced complementary metal oxide semiconductor technologies. The project will develop processes capable of forming a thin, continuous buried oxide (BOX) layer and at the same time reduce the number of defects in the silicon and BOX films. This project could lead to increased penetration of the microelectronics market by SOI, which is a key technology for reducing the enormous energy consumption now attributed to computers and other high-tech microelectronic equipment.

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Title: Production of Endohedral Fullerenes via Ion Implantation

Laboratory: Oak Ridge National Laboratory

Principal Investigator: Saed Mirzadeh

Industry Partner: TDA Research
Denver, CO

Amount of Award: $60,000

Brief Summary: The objective of this project is to investigate whether commercial quantities of endohedral fullerenes can be produced by ion implantation using ion beams of very high intensity. Applications include the use of boron atoms trapped inside fullerenes for boron neutron capture therapy.

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Title: Pt/CZT Interface Chemistry and Device Performance

Laboratory: Pacific Northwest National Laboratory

Principal Investigator: Daniel Gaspar

Industry Partner: eV Products
Saxonburg, PA

Amount of Award: $60,000

Brief Summary: The objective of this project is to develop an understanding of the interfacial chemistry between the surface of a planar cadmium zinc telluride (CZT) radiation detector and deposited platinum electrodes in relation to device properties. The goal is to minimize the leakage current and maximize the breakdown voltage of the device by controlling the electrode structure. Applications for the radiation detector technology targeted in this project include medical and industrial x-ray imaging, nuclear medicine, and nuclear safeguards and non-proliferation.

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Environmental and Biomedical Research

Title: Current-Time Monitoring of Phytoremediation Performance

Laboratory: Argonne National Laboratory

Principal Investigator: Cristina Negri

Industry Partner: Applied Natural Sciences
Hamilton, OH

Amount of Award: $60,000

Brief Summary: The objective of this project is to develop a system to monitor the performance of phytoremediation in "current time" by elucidating the unclear relationship between root growth/density, actual contaminant(s) concentration and mass in the soil, and contaminant(s) rates of plant uptake and degradation. This project could enable the perfection and expansion of the application of phytoremediation for soil remediation since it would allow the study of ways to improve root exploration of the contaminated soil.

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Title: Miniaturization and Commercialization of a Pico-Scale Assay for Cadmium in Biological Samples

Laboratory: Argonne National Laboratory

Principal Investigator: Maryka Bhattacharyya

Industry Partner: None

Amount of Award: $38,300

Brief Summary: The objective of this project is to develop a miniaturized assay that will allow researchers to accurately determine for the first time the concentration of cadmium in small volumes of blood or urine from persons exposed to cadmium only via environmental pathways. Because cadmium is used as an electrode in the environmental processing of spent fuel elements in the nuclear reactor fuel cycle, this assay applies to monitoring health and environmental effects of that emerging energy technology also.

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Title: Biologically Mediated Synthesis of Doped Magnetic Nanocrystals

Laboratory: Oak Ridge National Laboratory

Principal Investigator: Robert Lauf

Industry Partner: None

Amount of Award: $45,000

Brief Summary: The objective of this project is to advance a novel bacterially-mediated inorganic synthesis process, specifically for the production of mixed-oxide ferromagnetic nanocrystals. The project will characterize the electrical and magnetic properties of the nanomaterials, and define the parameters of a production-scale system to determine the viability of the process in the real world. Magnetic nanoparticles are useful for improved magnetorheological fluids for applications in active damping and for advanced power transmission devices such as fluid clutches.